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LATENT EXOPHORIA and THE REDUCTION OF OCULAR REFRACTION

With Special Reference to Tetanus of Ciliary and Recti Muscles*

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Foreword

The vast literature concerning the measurement of ocular refraction and muscle anomalies which has poured from the presses for decades has dealt almost entirely with muscular systems assumed to be *at rest*,[1] either naturally so or artificially so, as when cycloplegics have been employed.

In this monograph it is the author's purpose to demonstrate that this condition of rest is not as common as is generally supposed, and an endeavor will be made to explain why a state of tension so frequently exists and how it can be rectified. Its symptoms and profound effects will also be touched upon briefly, the latter because they thrust serious problems upon the refractionists which, if not satisfactorily dealt with, sometimes lead to disastrous results.

This particular type of eye-strain, which is latent, involves so many more subjects than are commonly associated with simple manifest conditions that it will be advisable to refer passingly to them so that it will be easier to obtain a thorough understanding of the hypothesis or theory which has been created to explain *why* the condition exists. *That* it exists there remains no question whatever. And the determination of its magnitude and the means for correcting it are relatively simple problems to the experienced and competent refractionist.

It is quite true that the accompanying explanation of the fundamental cause of the tension (strain) may be erroneous, some of the rea-

[1]The term "at rest" is here used to designate a condition in which a muscle or muscular system is free from those nervous impulses which are sent for the purpose of accomplishing a definite contracture—a specific movement. It does not preclude normal tonicity impulses which are for the purpose of maintaining the muscle in a state of readiness so that it can respond instantly to "contractile" impulses. There is considerable uncertainty, however, as to what constitutes "normal tonicity," but this subject will have to be discussed elsewhere.

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soning employed untenable, some of the factors mentioned falsely interpreted, and so on, but should this be true, it in no wise mitigates the fact that the tension does exist, causes profound psychic and physiological effects, is discoverable, is measurable, and can be relieved. Furthermore, it is as strictly a refraction problem as, say, simple hyperopia. This is stated for the benefit of those who may fear that this study might lead them astray from orthodox practice.

Of course it should be understood that the writer does not pose as an authority upon any of the collateral sciences discussed, such as biology, anthropology, evolution, etc. In a somewhat superficial study of these subjects he has encountered factors which seem to corroborate a theory which has gradually become so plausible and intensified as to be accepted by him as perfectly logical and beautifully explanatory, and these factors are presented for consideration.

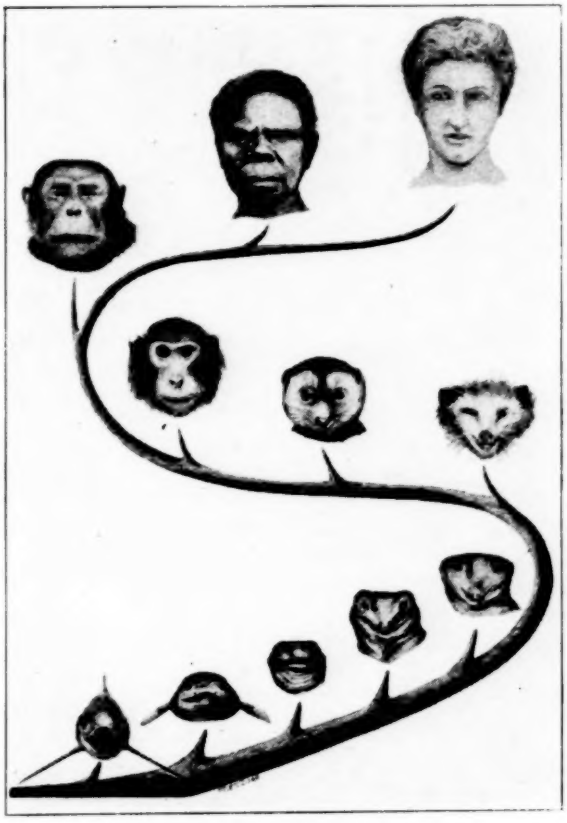
In some respects his opinions may differ from those of experts. It is quite possible that were he more familiar with the processes of reasoning by which they have arrived at different conclusions he would concur with them, but in the circumstances he can, with intellectual integrity, do not less than obey the trend of his own thought and abide by the consequences.

The theory which is advanced to explain the facts later to be presented in this article has its foundation in the accepted assumption that the functions of the human body and its ancestors have undergone considerable change over a period of millions of years, and that the anatomical mechanisms employed have accordingly altered in form and structure. In fact, it appears to be axiomatic in biology that "function governs structure."

There is some evidence of this in the vestigial membranes of various organs and structures which now appear to be without any known function or use in man but which in lower forms of life are often represented by more elaborate ones serving a definite purpose. There are said to be nearly one hundred of these in the human body. Evolution, then, is a matter of discontinuance and elimination as well as extension or complete change.

Now, if it be true that animal life has been built up and elaborated through a process of trial and error—and leading scientists the world over nearly all seem to agree upon this—it is logical to assume, first, that the process is still going on, and, second, that there therefore must be some functions and organs which are now at an intermediate stage of development, and that "biologic urge" is forcing them continually to strive, if not for perfection, then at least for an adaptation which will enable them to carry on their work with a minimum expenditure of energy. Nature steadily operates to bridge the gap between present accomplishment and ultimate purpose.

This lack of complete "complacency" constitutes a form of disharmony, and there are many such disharmonies in the animal body. They are



OUR FACE FROM FISH TO MAN.

Figure 1. Illustrating progressive changes from lower orders to Man. 1. Devonian shark; 2. Upper Devonian air-breathing, lobe-finned fish; 3. Lower Carboniferous amphibian; 4. Permo-Carboniferous reptile; 5. Triassic mammal-like reptile; 6. Cretaceous mammal; 7. Lemuroid primate; 8. Recent Old World monkey; 9. Chimpanzee; 10. Tasmanian; 11. Roman athlete. (Gregory. Our Face from Fish to Man.)

not always detrimental to the animal's ultimate welfare, for they often lead to adjustment to environment which means self-preservation. On the other hand, they sometimes lead to specialization which becomes so highly developed that the animal is more or less rigidly fixed in his environment, and when the latter changes to a degree beyond his limitations, he is not able to readjust quickly enough, and extinction is the penalty.

This is true of entire species and it is also true of individuals within each species. For each part in each individual is not developed equally, and should a change in environment call for a change in a certain function—an adaptation and adjustment of that function to a degree within

the limitations of the average—those individuals in whom the function is nearest to the new requirements will the more easily adjust to the new set of conditions. It is the old story of the survival of the fittest—elementary, of course, but it is a point of vital importance in the present study.

In Man himself there are many such disharmonies, as Metchnikoff so ably points out, thus leading to the inevitable conclusion that Man is not the perfect animal his enormous egotism once led him to believe. These disharmonies vary in magnitude in different individuals, some being deficient in one area, others in different areas. Possibly the greatest differences exist in the intellectual portion of the cerebral segment, a natural situation since it is among the youngest acquisitions of the species *homo sapiens* and therefore possesses the incompleteness of newness.

In so complicated and diverse a structure as comprises Man, it is quite natural that the most signal changes occur—or at least be initiated—in the nervous mechanism and its component parts. Of all animals this is especially true of Man, in whom nerve elements reach their greatest development. As a matter of fact, it is difficult to see how there could be much change without nerve involvement, although, as Parker[1] points out in mentioning the work of Steinach and Hertel upon the sphincter of the iris in lower vertebrates and even in the human eye, some primitive activities do take place without apparent nerve involvement. Aside from the cerebrum, and especially the intellectual areas, it seems to be in the visual system that nervous anatomy and physiology reach their highest form of expression. Certainly, outside the gray matter, there appears to be no area so complicated and sensitive, and no area, with one possible exception,[2] which has such a great influence upon cerebral elaboration.

It is quite in line with our argument to find in this system, especially in some individuals, conditions which lead us to the belief that the visual system of today is but at an intermediate stage of development and that it displays vestiges of a primitive state. Thus, one of the latter—the power to abduct—which is of uncertain value in a normal pair of eyes, seemingly is a relic of that stage of animal development in which the eyes were not associated, the one with the other, and the power of individual rotation toward the rear was an essential to continued existence. This condition may, by taking some liberty with the definition, be termed a "vestige" of an original condition or situation.

But there is more substantial evidence of this in the particular type of case with which this article deals wherein the eyes not only can be abducted to an extent much greater than that which has been estimated to be normal, but, *when at rest*, they assume a position of actual divergence in the *conscious* individual. This word "conscious" is emphasized for the purpose of differentiating between divergence during consciousness

[1]Popular Science Monthly.

[2]Reference is made to the influence upon the brain by the development of the human hand. Dr. Frederick Tilney accords it first place.

and that divergence which is said to take place in the sleeping or otherwise unconscious person.

This divergence is believed to be a true vestige of an earlier and more primitive state. That it appears to exist in at least 30 per cent of those who have applied to the writer for an examination, in contradistinction to extremely few with the opposite condition, is held to be highly significant. It tends to confirm the belief that parallelism and convergence of the eyes is a more recent acquisition than any other motile quality or faculty, that it still is an undeveloped function *in many individuals*, and that these individuals pay the usual price—in nervous energy—in obeying the insistent demand of Nature that, regardless of underdevelopment, they deliver to the human brain that material (sufficiently similar pictures) which has enabled the brain to sense the external world more accurately, through stereopsis, than any other form of animal brain and thus to become the most powerful instrument in animal life.

(To be continued in the October Issue)

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THE TRIMODAL FREQUENCY OF AMETROPIA*

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Up to the present time the general conception of ametropia, is of a dimodal nature, i.e., in practice we expect two classes of ametropic individuals. The first, we consider as those of anatomical errors, i.e., myopic, astigmatic, and hypermetropic; and the second class, as that group of individuals who suffer from physiological errors, i.e., lack of efficient muscular energy, sufficient for their accommodative needs, and are consequently considered as presbyopes. Under the heading of the first group we include asthenopes. Thus in practice when an individual consults us, he is either of the asthenopic (embracing the anatomical errors) or the presbyopic class, and we accordingly treat him as such.

The following paper at the outset, is an attempt to show that ametropia in general, cannot be considered as a dimodal frequency, but as a frequency of a trimodal nature. The evidence of this statement is based upon the results, and conclusions drawn from many examinations, of ametropes when considered "en masse."

The following paper is an elementary survey of ametropic individuals, based upon conclusive statistical evidence. These individuals include both males and females. The source of the data used in this investigation was that of an optician, whose practice was both wide and intensive, and covers a large area of the London district.

The writer is of the opinion, that this type of individual source is preferable to a large number of separate ones, as the personal equation in each separate examination would be different, as each individual observer has a different personal equation, which would complicate matters. In some cases the value would be positive and in others it would be a negative value, and accordingly which should be taken as the undisputed standard?

Thus the writer is justified in taking one source, as his standard, for the personal equation would be as near a constant as can be gov-

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erned by human agencies. This factor is further enhanced by the fact that the locality was a standard type; as shown in other investigations. The results in such questions as the myopia percentage in the community, is entirely in agreement, with the value determined by many authorities. In many other such questions as this, the individuals are such, that no localized or district anomalies are manifest, to have any bearing on any results determined, in these questions or in others that were discussed.

The general status of the subjects were of the middle and working classes; thus their requirements were in all probability a question of necessity. Hence a psychological factor is brought out, as to why they came for examination at a specified age, and for what particular purpose. Patients need to be helped to realize that certain aspects of life are worth while such as their ocular well-being, and need to be encouraged to take trouble about their eyes.

The investigation itself, confines its attention around the age differences of the subjects, who come for their ocular treatment. It is the manner in which the subjects react to their ages for the eye examinations, does the question of the grouping into a trimodal frequency come about, and suggest itself into a concrete feature of genuine reality. As the age factor is the one that governs the investigation then the age frequency could not be considered as a complete entity. For this reason the ages of the subjects were divided into definite groups. The age groups were divided into periods of every five years, from the age of 15 to the age of 65 and over. All cases below and up to age of 15 were considered as one complete group as were those above the age of 65. In reality it would have been better for the juvenile age group to have been considered as three groups, and also for the old age group. But these cases were required were for another investigation wanting more or less the same number of cases in each age group.* Otherwise there would have been very few cases in very early youth, and also in extreme old-age. The intermediate ages between 15 and 65, were divided into a quinquennial grouping.

All the numbers of cases, existing in each of the separate groups, were calculated to a percentage basis, and the numerical amounts given for comparison. Whole numbers cannot be accounted for as the size and mass weight in each group would not be the same. Thus for the sake of accuracy, a survey based upon percentages would be of far greater value.

Tables of figures and graphs are given. The actual equations of them are not calculated, as their order of approximation to a mathematical frequency, is not of a sufficient order of accuracy to merit the applica-

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*"A Survey of Refractive Errors," by W. Gasson; "The Optician and Scientific Instrument Maker." March 4, 11, 18, 1932. The text of a lecture given to the Surrey Optical Society, February 16, 1932, and before the Optical Society of the Northampton Polytechnic, London, England, on February 24, 1932.

tion of mathematical principles, such as the rate of change to a curve, or series of curves, as obtained in a statistical investigation of this nature.

For the purposes of the whole investigation, similar numbers of cases in each sex were taken, for accuracy in comparison. There were 2,218 males and 2,200 females. The two sexes were considered as separate entities so as to bring out any sex differences and peculiarities. Many sex idiosyncrasies were brought to light by this means, which would have otherwise remained a latent characteristic. In order to emphasize the reality of the values that then were found, a smaller group of males were taken, intentionally a 1,000 less, to show that the same peculiarities were inherent in each batch of cases. Thus we can and should be prepared to admit the reality of the facts that are brought to light.

As a final word about the group association of all the males and the females, that during a specified time interval, namely, 1922-1930, apart from any retests of any previous or included ones, (which would have practically doubled the sum total) there were 1,218 males and 1,879 females, an approximate proportion of 2:3. This difference is probably due to several reasons. The first is that the men are outnumbered in the general community. The second is that women are more careful in their ocular well-being than the men. Thirdly, that the locality was of a semi-suburban type, so that the men would probably have their refractive errors attended to in the city. The fact that the women look after their eyes more than the men is clearly brought out in the investigation.

In order to facilitate the conception of the frequency reaction of the cases in question, to their ages, we can easily refer to this in a simpler and more concise manner as, the percentage of cases expressed per group. That is the number of cases per group, i.e., age group is expressed as a percentage of the whole.

The manner in which the cases came for their eye examination, i.e., their ocular reaction to the age variable, was considered in the following manner. The two large groups of the 2,218 males, and the 2,200 females were put into the same table, and for the sake of emphasis and comparison the smaller group was isolated. As the same reactions in the smaller group in the females would be the same as for the large group of 2,200 cases, a second comparison was considered as being unnecessary.

The following table for the two large groups, shows the relative distribution of cases in each of the successive age groups:

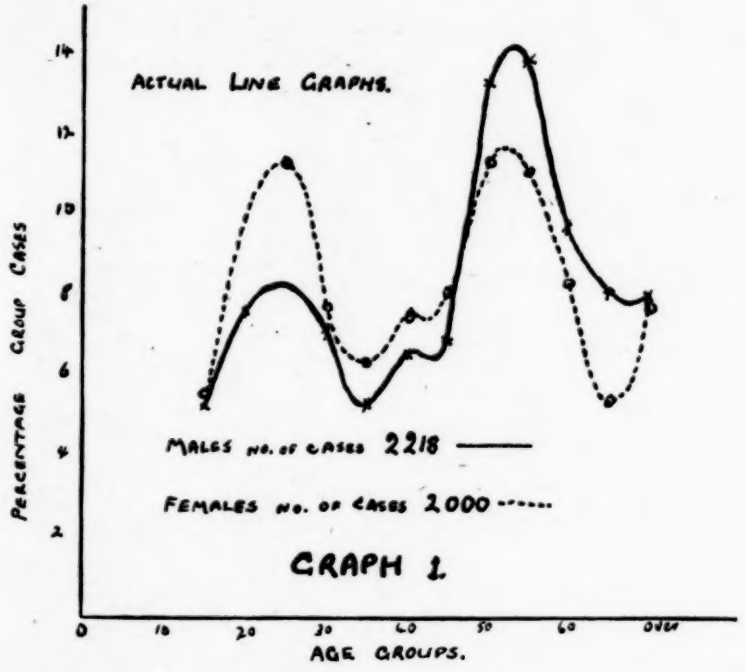
Age	15	20	25	30	35	40	45	50	55	60	65	Over
No.	118	168	195	158	120	145	151	293	306	214	179	171
Males %	5-22	7-60	8-22	7-14	5-33	6-54	6-82	13-2	13-7	9-65	8-10	7-93
No.	122	216	247	172	140	164	177	250	243	182	118	169
Females %..	5-4	9-82	11-2	7-83	6-37	7-46	8-05	11-4	11-1	8-27	5-37	7-68

Similarly in the smaller group of males consisting of 1,218 cases, another table is drawn up as follows:

Age	15	20	25	30	35	40	45	50	55	60	65	Over
No.	53	89	114	98	78	91	78	154	159	103	106	98
Males %	4-35	7-33	9-36	8-04	6-15	7-36	6-42	12-6	13-0	8-45	8-86	8-04

The number refers to, how many cases at the particular age group, and the percentage value of that number with reference to the total number of cases. For the purposes of this investigation, the percentage basis is the one that is adopted throughout, as it is the more convenient.

The percentage values are plotted both by the histogram method and the ordinary way. There is no intrinsic difference between either method, but the emphasis of the trimodal grouping is shown up to a greater advantage in the histogramic representation. The line method has been included, as it is the one that is usually employed. From these graphs the frequency representational curves have been drawn to illustrate the psychological functions that are manifest. For this means, the graphs have been drawn down to the a horizontal axis, the x abcissa, which in this case the age group variable. Two sets of graphs are drawn, one for the large groups of the two sexes, and the other for the smaller group of the males only. This was for the use of comparison only:



GRAPH 1.

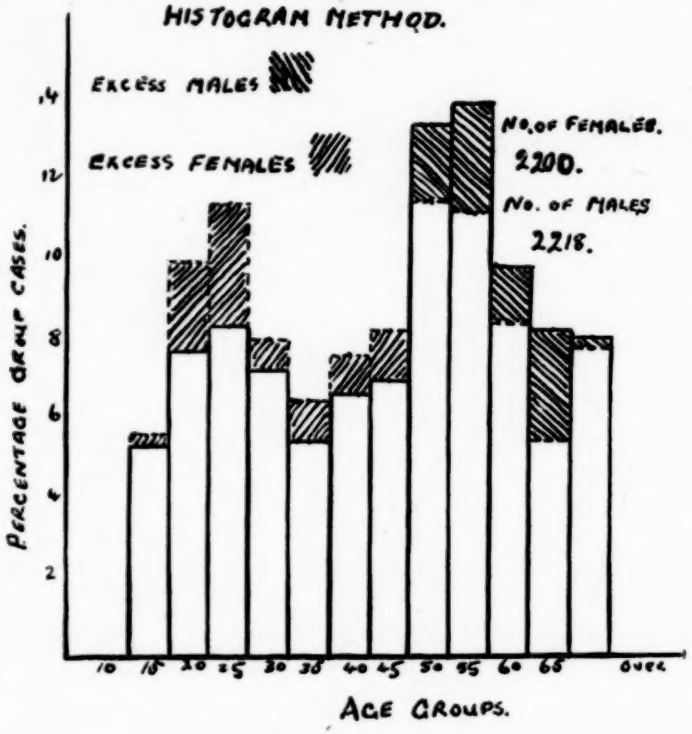
Graph 1 shows the reaction of the age in ocular needs, in each of the two sexes. This clearly demonstrates the sex difference in the age regions of 5-35 and 45-65. This is more clearly illustrated in graph 2, which is the Histogramic representation of the previous one.

The following features immediately show themselves. Firstly, there is a great clustering of cases about the age of 25, and again at the age of 55. These are the ages where the asthenopic, and presbyopic com-

plaints are found. In the presbyopic region, the subject thinks that his distance vision is quite normal, requiring as he sincerely believes a correction for reading and nearwork. As is often found to be the case, a fair amount of distance correction is rendered necessary, in order to get the quasi—good distance vision as well as possible.

As is seen in Graphs 1 and 2 the expected increase in the percentage group cases at the ages of 35-40, tc form the subsequent presbyopic group is not as much as would be expected. In fact, any increase, if actually present, suggests that there is some function existing of a latent nature, which does not include the subjects at these particular ages.

In the smaller group of the male cases there is actually a diminu-



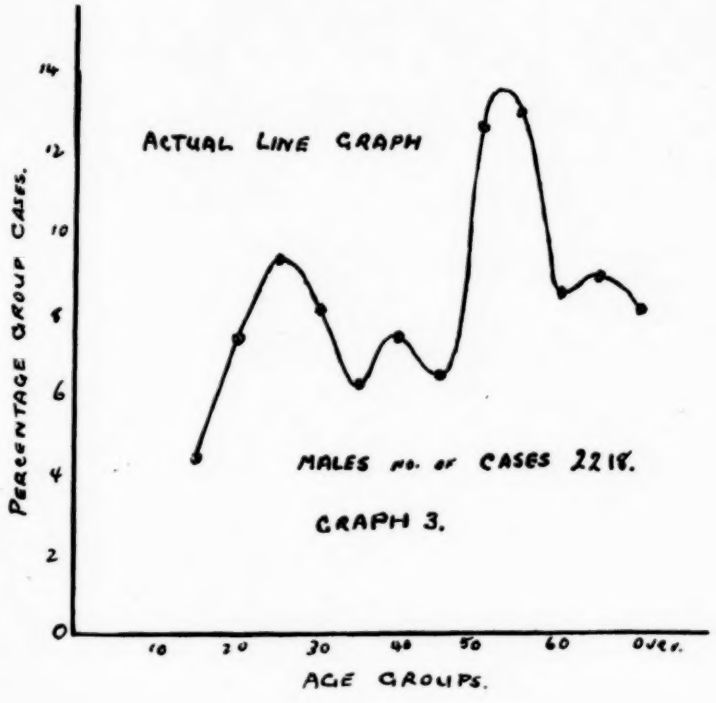
GRAPH 2.

tion in percentage at the age of 45 years. This emphasizes the authenticity of this suggestion. Hence the juxtaposition of the graphical points in the smaller group of males, as shown in graphs 3 and 4, definitely shows the trimodality of the reaction, of the age frequency to refractive troubles:

The frequency curves showing the Trimodality of Ametropia, are deduced as explained previously into three overlapping graphs, with definite "peaks" at their maxima. By this means our evidence can be studid by an intensive examination into the causes of these phenomena.

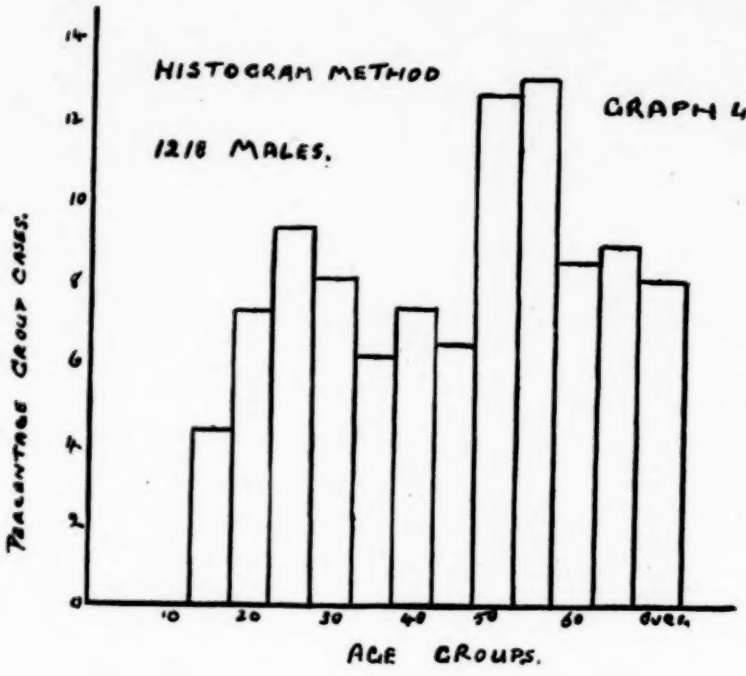
These phenomena exist in, both the bi-sexual graph and the mono-sexual graph, although the latter deals with a smaller number of cases. This is clearly shown in graphs 5 and 6.

As these curves represent a physiological reaction, which incorporates the element of psychology, we must not be very surprised to know that the graphs 5 and 6 are perfect examples of psychological curves. The curves are those obtained in many statistical investigations of which this paper is, as the writer believes, includes for the first time an amotropic variable with respect to age. These age reaction curves, are perfect examples of "Normal Curves" or "Curves of Error." This has necessitated

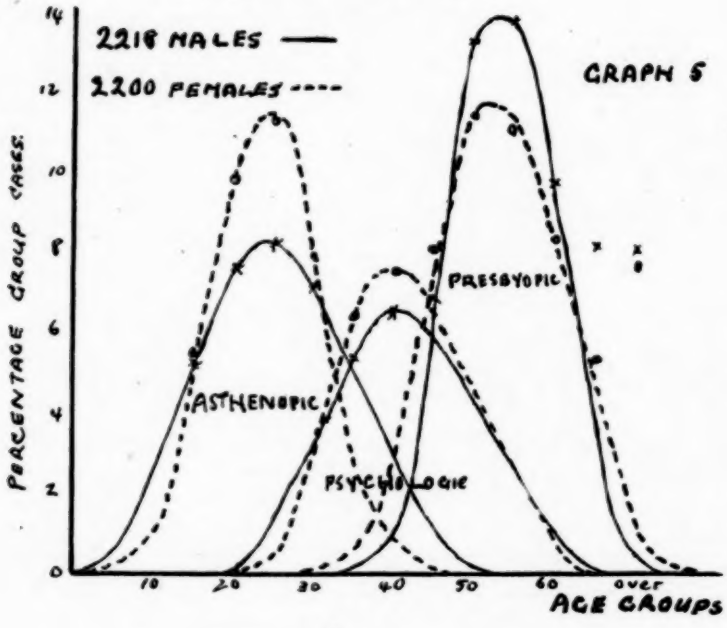


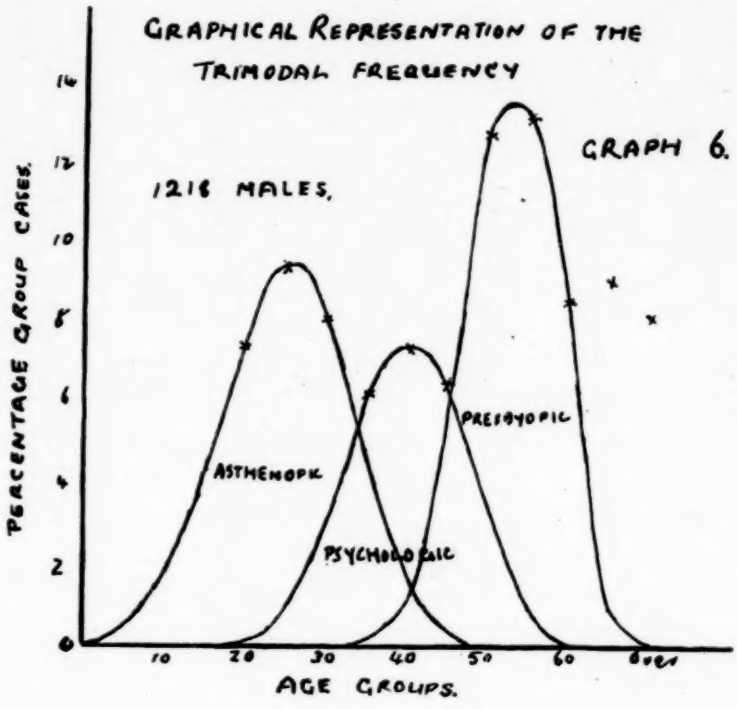
the continuation of the curve to be drawn down to the x abcissa. The overlapping of the sections are an all-important feature which calls for some explanation.

This important type of frequency curve, of "Curve of Error," is one that is often being concerned with psychological analyses, and statistical surveys. Familiarity with its form and properties is essential to all students of practical psychology. The actual interpretation of this investigation can thus be considered as a psychological study of a physiological function.



GRAPHICAL REPRESENTATION OF THE TRIMODAL FREQUENCY.





The "normal curve" or the "curve of error," has a definite mathematical formula. The functional formula is of a nature similar to:

$$Y = Yo. \left(1 - \frac{x^2}{a^2}\right)^m$$

where m is a positive power.

In our case for instance, the "Y" value represents the percentage group cases, and "x" the age groups. The "Yo" value is the maxima value for the curve (thus there are three independnt "Yo" values for each of the three overlapping "Normal Curves"). These maxima occur at the ages of 25, 40 and 55. The "a" value is an arbitrary function bound up with each individual "Normal Curve."

Another way of representing this function is by the following formula:

$$Yx = Yo\, e^{-\frac{x^2}{2\sigma^2}}$$

Where "e" is the value of the base of the Naperian logarithms, "x" the deviation from the mean, "Yx" the frequency of the mean value, and "o" the standard deviation of the distribution.

Apart from any internal or latent causations, it is easily seen that the relative size of the three reactions, in each of the two sexes are not the same, either in size or in frequency. According to these differences, we see that the females are more prone to asthenopia than the males. That there are more females reacting to psychological aptitudes than the males. Also that the males are more affected by presbyopic symptoms than the females.

Furthermore, as regards this arbitrary trimodal grouping of the communal ametropia, the three modes are due to specific causes as well. The asthenopic group (this embraces myopia and hypermetropia) is due to the static anatomical causes. That is, either the curvature of the globe or the cornea; is not correct; or the eyeball is too long or too short as the case is: or perhaps the crystalline lens may be of a slightly higher refractive index for the particular individual, making a host of independent causes for the first group.

The intermediate or the psychological group is actually a deferred conditional reflex of the asthenopic group, or a premediated reflex of the last group. The question of the psychology of the individual is bound up with the question, "why did the subject come for his ocular examination at that particular age when he had already ceased growing?" The question of growth, that is body growth, generally decides the nature of the refractive error that requires correction.

Generally speaking, whilst other things being equal, the question of body growth, is the deciding factor in the first group, which has been called for convenience the asthenopic group. The eye itself grows with the body, and hence when body growth ceases, the condition of the eye should be quite settled. Hence any anatomical error manifesting itself during this growing period, generally resulting itself as a refractive error, necessitates the visit for optical treatment at this period. Thus all the anatomical errors, automatically fall into this first group.

The reason for the size of the last group, i.e., the presbyopic group being so large is obvious. It is at this time starting about the age of 40 or thereabouts, that the subject's physiological troubles commence, i.e., inability to see near objects with comfort, requiring assistance for their near work. Hence increasing numbers of cases are coming for examination, from the age of 40 to the age of 55, and then the numbers of cases begin to drop off, because the amount of subjects begin to die off.

The next important question that automatically arises, is that how do these groups of individuals, which are universally accepted, reconcile themselves with the existence of the third group which falls midway between the two and overlaps each of them?

It is difficult to imagine a presbyope of 35, hence the presbyopia is not the factor that is the cause of this in the "intermediate" group, and cannot be the reason of the visit of the patient at this age. The presence of this group is quite definite, as the middle "peak" or maxima shows. Thus it is a question of mind governing matter that is the cause of the presence of this group.

It seems that these psychological cases, coming for their first examination at the ages of 30-45, are due to the inner workings of the subject's mind. It must still be remembered that these cases are not re-tests, but their first visits, as with all the other age groups. Thus these people would have, under normal circumstances, come for examination in the first group. Then we must look for the causes, that have delayed their visitation over a period of about 15 to 20 years or more.

One such suggestion, is that the subject dislikes the idea of wearing glasses. Another might be that they have endured their headaches, etc., and even bad vision, until it becomes really unbearable. Perhaps the question of expense entered the problem as well, which is not at all unlikely. In any case, it is some question of the mind that is the root cause of this feature, and thus the patient must be treated accordingly. In other words the examiner must act upon the subject's mind in such a manner as to convince him or her of the utility of the use of the glasses. Moreover, a judicious question regarding the reason why the subject never came at an earlier date, would add to the interest of the examination.

Working upon this assumption that these people, forming the "intermediate" group, are subjects who have reacted to psychological causations; it calls for a different line of approach to the subject when giving him or her the instructions and advice regarding the use of the prescribed glasses, that would be adopted; if it had been either in the first or last grouping of the communal ametropia.

The existence of this "intermediate" group, or "psychological group," is not a mathematical fluke obtained from a professional source of material. This group contains approximately 400 actual cases, out of 4,418 cases (both males and females), which is a rough percentage of 10 per cent out of the general community. This is an amount that is no more coincidence but even more than a weighty proposition.

Moreover, we may expect as the male is more consistent than the female (the female being more plastic), that the males are more nearer to the communal average than the females. Also that the changeability in the outlook of the female causes the female errors to be more erratic of the two sexes. Hence we find uniformity existing in the male, whilst irregularity is to be expected in the female. For these reasons alone do we find the relative sizes of the three modes to be different, although a correspondingly equal number of male and females were taken.

Asthenopia is due to static anatomical causes and the presbyopia due to dynamic physiological causes. The "intermediate" group is neither one nor the other, as it is a dynamic form of the static condition, hence, as the author believes, due to psychological causations.

The reasons for the mode differences, i.e., the sizes of the individual groups, are probably due to sex differences, with respect to the fact that the female at the same age as the male is relatively in advance as regards mental development. Thus such things as the mode displacements can be explained in these terms, where the two sex modes do not laterally coin-

cide. Also the fact that the female is more prone to asthenopic symptoms, as is clearly shown by the large difference in the asthenopic modes. Similarly other features can be shown.

In conclusion the author wishes to acknowledge the cooperation of his father, namely, A. Gasson, F.B.O.A., for the use of his personal records and the illuminating advice which he willingly gave.

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CROSS-CYLINDER METHODS OF MEASURING ASTIGMATIC ERRORS*

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The purpose of this article is to encourage the more general use of the cross-cylinder, for determining cylindrical requirements.

While this valuable technique has often been described in various publications since Dr. Edward Jackson developed and explained the test many years ago, it is probably true that not 10 per cent of refractionists today sufficiently recognize its value in detecting astigmatic errors—nor the accuracy with which the true cylindrical acceptance may be ascertained.

The writer appreciates the seeming simplicity of the subject presented. Nevertheless, the following detailed explanations of the effects produced when a cross-cylinder is applied to an eye with known and also unknown cylindrical requirements, may help to make this technique more efficiently understood and more frequently used.

To become efficient in the use of cross-cylinders, necessitates alertness in mental interpretation of the refractive effects created by additional lens combinations which may be placed before an eye. In dealing with astimgatic errors, it must be remembered that an "*interval of Sturm* exists"—and it must be eliminated.

It seems unnecessary to describe the cross-cylinder test lens itself. Suffice it to say that a cross-cylinder is in effect simply a sphero-cylinder, the cylinder of which is exactly twice the strength of the sphere. A 0.25 cross-cylinder is simply a —.25 sphere combined with a +0.50 cylinder or a +0.25 sphere combined with a —0.50 cylinder. A 0.50 cross-cylinder is a —0.50 sphere combined with a +1.00 cylinder or a +0.50 sphere combined with a —1.00 cylinder.

When it is one's custom to refract with minus cylinders, as the majority of phoropter users do today, it may simplify the test to think of a cross-cylinder as a plus sphere combined with a minus cylinder. Although, if one prefers to work with plus cylinders and with the accommodation always under proper control, the results are subjectively the same. As the readings of the ophthalmometer are usually spoken of as minus cylinders, the interpretation and use of cross-cylinders in exam-

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ination routine may be less confusing, if applied as a plus sphere combined with a minus cylinder.

Regardless of whether the minus or the plus cylinder is used in interpretation, it is necessary to keep in mind, the location of the minus axis, which has a plus effect, and the plus axis, which has a minus effect.

There may be a slight difference in the subjective cylinder acceptance and the ophthalmometer reading, on account of the distance the correcting cylinder is essentially placed anterior to the cornea—and also the effect that a strong spherical requirement may influence the cylindrical requirement.

In analyzing cases with good vasual acuity—and those cases in which little astigmatism exists, only the weaker combinations are required. Although the existence of a large interval of Sturm may often be more readily detected if the combination of +0.50 sphere ⊂ —1.00 cylinder is used first. The advantage of the occasional use of stronger combinations will later be appreciated.

That the explanations which are to follow may be more thoroughly understood, and to make the mental analysis more simple, we will first analyze the effect of a cross-cylinder, when applied to an emmetropic eye. A +0.25 —0.50 test lens is used in this test.

As there is no *interval of Sturm* or astigmatic interval in the emmetropic eye, the application of the cross-cylinder creates one. If this +0.25 sphere ⊂ —0.50 cylinder test lens is held before an emmetropic eye, with the minus axis at 180°, the horizontal meridian is made 0.25 myopic and the vertical meridian is made 0.25 hyperopic. If the axes of the test lens are now reversed, the horizontal meridian is made 0.25 hyperopic and the vertical meridian is made 0.25 myopic. Both positions create an interval of Sturm of the same degree; the same amount of blur is produced to this emmetropic eye, regardless of the position at which the cross-cylinder is rotated. The same blur, the same astigmatic interval is created, if the test is applied to a corrected myope or hyperope, if the eye is free from astigmatism.

(I appreciate the view of many refractionists, who thoroughly believe in the existence of astigmatic accommodation—and the influence that such abnormal ciliary function may have upon subjective as well as dynamic findings.)

It hardly need be mentioned to the readers of this scientific journal, of the necessity of correcting the manifest spherical ametropia fully, before the cross-cylinder test is applied. It is sometimes desirable in certain hyperopes with hyper-tonicity of accommodation, not to crowd the plus sphere too strong before the cylindrical requirement is determined.

Now, we will consider the effect of a +0.25 sphere ⊂ —0.50 cylinder test lens, with its axis at 180, applied to a naked eye, which possesses simple myopic astigmatism, requiring for correction a —0.50 cylinder axis 180. Picture this eye as emmetropic at axis 180 and myopic 0.50D at axis 90. If we apply the +0.25 sphere ⊂ —0.50 cylinder at

axis 180, how is the interval of Sturm affected? It is eliminated by the effect of the minus 0.50 cylinder portion of the test lens, but the plus 0.25 part, creates just this much simple myopia in each meridian. A slight blur still exists.

If we apply this cross-cylinder to this same eye, with the minus axis at 90, what happens to the interval of Sturm? The plus effect at axis 90, creates 0.25 additional myopia at 90, and the minus effect at 180, produces 0.25 of hyperopia at 180. More astigmatism is created, the interval of Sturm is increased and vision is much more blurred.

If a simple —0.50 cylinder axis 180 is now inserted in the trial frame to correct the apparent myopic astigmatism—and the cross-cylinder test lens is again applied with its minus axis exactly over the axis of the —0.50 cylinder in the trial frame, the same degree of blur would be produced as previously occurred to the emmetrope discussed. An interval of Sturm of the same degree, the same amount of blur, would be thus created regardless of the position at which the cross-cylinder may be held before the eye, provided the *axis* and *strength* of correcting cylinder in trial frame is the true requirement.

Now we will analyze a more complexed hypothetical case. Suppose the objective and subjective findings indicate the need of +1.00 sphere ⌒ —2.00 cylinder axis 15, acuity 20/20. The astigmatic interval is now supposed to be eliminated. To determine if any interval still exists, we now hold the +0.25 sphere ⌒ —0.50 cylinder test lens, with the minus axis exactly over the axis of the —2.00 cylinder in the trial frame or phoropter, i.e., at axis 15, and learn from the patient the effect it has to vision. The cross-cylinder test lens is then quickly reversed so that the minus axis is at 105. If the same amount of blur is produced when the axis of the cross-cylinder is held at both these meridians, the —2.00 cylinder in the trial frame is thus proved to be the best cylinder acceptance.

But, if the vision is *"less blurred"* when the minus axis of cross-cylinder is at axis 15 and *"more blurred"* when at axis 105, the minus cylinder in the trial frame should be increased—and the test repeated. However, if when the minus axis of the test lens is held over the —2.00 cylinder at axis 15, vision is "more blurred" than when held at 105, the —2.00 cylinder in the trial frame must be reduced. It cannot be too much stressed, that when the cylinder in the trial frame is correct in strength and axis, the application of the cross-cylinder will create an "astigmatic interval" and produce the same amount of blur in both meridians.

When an objective examination has previously been made and the principal meridians thus determined, the rotation of the cross-cylinder before the various meridians of the eye to ascertain these principal meridians, is not so essential. Nevertheless, for quick approximation of these meridians, the cross-cylinder test is superb. The stronger combinations of course producing a larger "interval of Sturm" when applied reversed,

are more effective for quick demonstration when considerable astigmatism exists.

While the use of the cross-cylinder is superb for determining the best cylindrical acceptance, the greatest value is perhaps in locating the most acceptable axis.

The principle upon which this axis locating technique is based, is the fact that when two cylinders are superimposed, "a new cylinder is created with its axis somewhere between the axes of the two cylinders." If the two superimposed cylinders are of the same character and strength, the new axis created will be midway between the axes of the two cylinders. A certain amount of sphere will also be created and the relative strengths of the newly created sphere and cylinder will depend upon the number of degrees existing between the two axes of the superimposed cylinders. When these two superimposed cylinders are not equal in strength, the newly created axis will be nearer the axis of the stronger of the two cylinders.

Suppose the cylinder in the trial frame is —1.00 axis 180. We wish to determine if axis 180 is correct. If we hold a +0.25 sphere ⌒ —0.50 cylinder or a stronger cross-cylinder, with the handle *exactly* at 180, the minus axis of the cross-cylinder will be located either at 45 or when reversed, at 135. If axis 180 is correct for the —1.00 cylinder in the trial frame, the visual acuity will be the same when the axis of the cross-cylinder is either at 45 or 135. But, if vision is "less blurred" when the minus axis is at 45 than when at 135, the axis of the cylinder in the trial frame should be placed to an axis nearer 45. Just how much must be determined by "trial and error." We will try it at axis 15. We now hold the handle of the cross-cylinder precisely at axis 15, which of course places the minus axis of the cross-cylinder at either 60 or 150. If vision is now "more blurred" when the minus axis of the cross-cylinder is at 60 than when at 150, the minus cylinder in the trial frame should be placed somewhere between 15 and 180. With a few trials in reversing the minus axis of the cross-cylinder, always remembering to hold the handle so that the cross-cylinder axis is exactly 45 degrees from the cylinder in the trial frame, a position will quickly be found, where reversing the cross-cylinder axis will cause the same amount of blur in each meridian. This will be the most acceptable axis for the cylinder in the trial frame.

After determining the most acceptable axis for the trial frame cylinder, a recheck should be made to ascertain if the *strength* of the apparent correcting cylinder is the most efficient. The blur produced by the cross-cylinder will not be the same at the two meridians unless the trial frame cylinder axis is correct.

As some refractionists work entirely with plus cylinders, a case will now be analyzed, using the plus cross-cylinder interpretations. If a trial frame combination of +1.00 sphere ⌒ +1.00 cylinder axis 90, is indicated by objective and subjective technique and we wish to determine by the cross-cylinder test if the cylinder is correct, it is usually best to first determine if the axis 90 is the most exact axis. As we are now dealing

with a plus cylinder, it will simplify the test to now regard the cross-cylinder lens as a —0.25 sphere ⊂ +0.50 cylinder. We now hold this test lens with its handle at *exactly* 180, which of course places the two axis each 45 degrees from the axis of the cylinder in the trial frame. If the plus axis is at 45, it should now be reversed to 135 and the effect of rotating the cross-cylinder plus axis to these two meridians should be noted. If vision is "less blurred" when the plus axis is at 135 than when at 45, the axis of the trial frame cylinder needs to be placed more towards the 135 meridian. If we now place the trial frame cylinder at axis 105 and the cross-cylinder is now applied again, the handle must be held at axis 15, which places the plus axis of the cross-cylinder, now at 150 or when reversed, at 60. The position of "least blur" should again be noted —and the trial frame cylinder turned to a position, where, when, and if, the plus cross-cylinder axis is *exactly* 45 degrees therefrom—the same degree of blur will be produced, when reversed. This will be the best axis for the plus cylinder in the trial frame.

Reviewing the test to prove the accuracy of the strength of this plus cylinder, assuming that axis 105 is the correct axis, we apply the cross-cylinder with the plus axis at 105 and then reverse to axis 15. If the cylinder *strength* is correct, a slight blur should occur at *both* these meridians. If "less blur" is produced with the plus axis at 105 than at axis 15, a stronger plus cylinder is required in the trial frame. If "less blur" occurs when the cross-cylinder plus axis is at 15, a weaker cylinder is required in the trial frame. If much change in the cylinder strength has been made, a recheck of the axis should be repeated.

When cylinders of low power are rotated before the eye, it is often difficult to determine the correct axis; as great change of cylinder axis is created by rotating the axis of the cross-cylinder 45 degrees in each direction from the trial frame axis, the effect produced is very marked and the most efficient cylindrical axis is easily ascertained.

After the true cylindrical acceptance has been determined, the proper spherical requirements, as indicated by other analytical technique, is more effectively prescribed.

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CASE HISTORY, EXTERNAL EXAMINATION, OPHTHALMOSCOPY*

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The above heading, in my opinion, constitutes three of the most important steps in an examination by an ocular practitioner. These three steps are, as a rule, so grossly neglected that I continue to marvel at the degree of success we have in dealing with our patients.

The cards and forms in general use, for recording this information, are very near 100 per cent inadequate. Most of them are ridiculous from this standpoint. Some of the forms merely have one line each for case history and ophthalmoscopy. Others have a numerous array of diseases and symptoms printed in such a small space, that it would be quite impossible to make any notations of your own. Such forms are even dispensed by our National Association.

Of course, I am judging by the so-called "standard forms," and others which I have seen in use, in addition to gathering impressions from talking with various men in this field. When these steps are mentioned at all on these forms, the actual investigations are not encouraged, by reason of the fact that sufficient space is not left in which to record findings. Therefore, I am convinced that these particular phases of the examination are the weakest in our chain of ocular investigations. Much progress has been made, however, aside from this.

An investigation of various clinical forms used in other specialties, reveals the fact that a great deal of importance is attached to case history, and quite lengthy provisions are made for dealing with this first step in any examination. I look upon such standard forms as a fairly accurate index to the evolution and progress of the professions thus represented.

I do not believe that any one of knowledge will dispute the real scientific value of these steps. They have a very true and definite value to the doctor and his patient. They are conducive to a more accurate diagnosis. As a matter of fact, the diagnosis and prognosis, and sometimes a clear understanding of the etiology of the case, must be largely based upon the information thus gained.

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Aside from the standpoint of scientific value, there is another phase involved, which automatically adds in a very large measure to the doctor's success in dealing with his patient. It is the psychological reaction on the part of the patient. It is admitted, and generally accepted, that unless the patient is properly impressed, and has confidence, no treatment by the doctor will bring maximum results. This important psychological factor must not be overlooked in our practices.

When a layman comes to you complaining with his eyes, with the idea of getting a pair of glasses, you make of him, in his own mind, one of two things: either a patient or a customer. And your success or failure with this layman will most likely be in direct proportion to the impression he gains from your first contact, until you discharge his case. If you make of him a "customer," your percentage of "grief" cases will automatically go up, regardless of your ability otherwise.

The average layman with whom we have to deal these days has a very good conception as to how a successful doctor, in whom he would readily place confidence, should conduct his practice. He has been in contact with the large institutions, hospitals, clinics, etc., or has heard his neighbors talk about these things, until he has come to expect thoroughness and efficiency on the part of any doctor he may consult.

The case history should be thorough. A full report should be recorded of any departures from normal, either in the general health of the patient, or in his ocular conditions. The usual procedure is to record the present and recent symptoms first, and then go back as far as you can into early infancy, and work up to the present.

I find it a good plan, just before proceeding with the external and ophthalmoscopic examination, to record the visual acuity, and to ascertain the exact distance the patient wishes to do his near work, such as reading, etc., and make a note of this. Then all of the near point tests and investigations are made, later in the examination, at least at this one particular point.

The external examination should begin with a study of the general appearance and attitude of the patient. This information may readily be noted during the process of history taking, and so recorded. The examination should then proceed by noting the facial characteristics, particularly about the eyes.

Look for enophthalmos or exophthalmus; lateral displacement of the globe; the presence of inflammatory swelling, etc. Investigate for paresis or paralysis of any of the external ocular muscles.

After making a careful examination of the lids and conjunctiva, cornea, iris coloration, condition of the iris and pupil, etc., the examination should continue with oblique illumination. The depth and clearness of the anterior chamber is noted. The depth is observed by noting the relationship of the posterior surface of the cornea to the anterior surface of the iris.

By oblique illumination, points of exudation, and pigment spots, may be detected on the anterior surface of the capsule. And valuable knowledge of the actual lens substance may also be gained by this method.

The size and shape of the pupil, and at least three of the pupillary reactions should be investigated. Direct light, Consonsual, Convergence reflex. These tests should never be neglected. They bear a very valuable neurological significance.

The ophthalmoscope should now be taken, and by observing the eye through the instrument, held some distance away from the patient, opacities in the dioptric media will readily be noted. They will appear as dark spots or clouds, on a reddish background. To locate these, it should be borne in mind that opacities in the vitreous are generally floating. The rapidity in the movement of the opacity is always in proportion to the condition of the vitreous, as regards its fluidity. Opacities in the lens and cornea are always immobile.

It can be determined whether the opacity lies back, or in front of the iris, by the apparent movement of the opacity when the observer moves his head. Another good way to localize the opacity is to focus sharply the pupillary margin of the iris, with the instrument held as in direct ophthalmoscopy, then figure the position of the opacity by the required change in lenses necessary to bring same in sharp focus. The vitreous body may also be studied by manipulating the lenses in the instrument, to bring into focus any particular portion.

When we leave the vitreous, and begin to study the optic nerve, which is the only one in the entire human structure that can be thus examined, and when we observe in the natural state, columns of blood circulating in the vessels, we begin to realize that the ophthalmoscope is, perhaps, the most valuable instrument known.

When we become expert in the technique, and can easily see these things, and are able to make an explorative examination of the entire fundus, it becomes fascinating beyond measure. There is nothing more interesting to me than this phase of the examination.

I shall not attempt to deal with abnormalities to be found, but would suggest that you thoroughly familiarize yourself with the normal fundus, and normal variations found, that you may readily detect any departures therefrom.

A good way to improve your knowledge in ophthalmoscopy is to cultivate the habit of firmly establishing in your mind each abnormal fundus picture presented in your practice, making it an invariable rule to review every available text book and other literature on the case, until you thoroughly understand the condition.

This step in the examination should not be concluded until the appearance, by transillumination, of the maxillary and frontal sinuses, and teeth, is noted. The patency of the nose, and the condition of the tonsils, should also be investigated.

The ophthalmoscopic examination should be supplemented by field studies. The extent of these investigations should depend upon the case with which you are dealing. The extreme peripheral fields, with the perimeter, should always be taken, however.

Central and para-central field studies with the campimeter may then be gone into. While it is not necessary to go into field studies on an extensive scale in every case, some knowledge of the fields should be recorded in each case.

In my practice, I devote one entire appointment of three-quarters of an hour, to case history, the external and ophthalmoscopic examination. The rest of the examination consumes from one to one and one-half hours, which is usually divided into two appointments.

I do not wish to digress too much from the subject in hand, but wish to impress upon you that a carefully appointed office with a professional environment, a complete case history, external and ophthalmoscopic examination, in every case, will contribute as much, or perhaps more, to your success than anything else. And I know from experience that patients are quite willing to pay substantial fees for thoroughness in the examination. It is not necessary to smother this fee and depend upon unreasonable profits on frames and lenses for a livelihood.

The regular form which I have been using in my practice during the past several years, is very comprehensive, perhaps unnecessarily so. However, ample space is provided for recording any conceivable data pertaining to the eyes, that the case might be intelligently studied at any time. This form is made up in booklet style, measuring 6x9 inches, and consists of twelve pages for recording data. Half of this booklet is taken up by case history, external examination, ophthalmoscopy, and field studies. In advocating the use of more elaborate forms, I do so, hoping that thoroughness in ocular examinations will be encouraged.

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CASES OF SUB-NORMAL VISION*

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The following case reports are presented from a group of fifteen similar cases, to indicate what can be done in cases of pseudo-myopia and partial amblyopia ex anopsia in the matter of improving vision and reducing the amount of correctable ametropia present. The technics followed are, of themselves, not necessarily new, nor is this type of work original with the author, yet he feels justified in presenting these reports for two reasons. First, not all optometrists as yet practice these treatment therapies, and it is hoped to encourage others to successfully handle cases of this character, and second, it is the author's belief that the ultimate future of our profession rests, largely, on our success with cases of this character. The following cases are, therefore, presented in some detail with these objectives in mind.

Case 1.

Patient, Miss A. R. Age 28. Occupation, court reporter. She came to me wearing the following correction:

O. D. — 200 D. Sph. ⌒ + 1.75 D. Cyl. axis 75. V. A. = 20/20
O. S. — 0.25 D. Sph. ⌒ + 0.25 D. Cyl. axis 105. V. A. = 20/20.

Her uncorrected visual acuity was O. D. 20/200, O. S. 20/20?.

The external ocular inspection and the ophthalmoscopic examination were negative. Pupillary reflexes normal.

The refractive findings were as follows:

Ophthalmometer.

O. D. Prim. 44.50 D. in 170 mer. X Sec. 45.75 D. in 80 mer.
O. S. Prim. 44.50 D. in 180 mer. X Sec. 4500 D. in 90 mer.

Static Skiametry.

O. D. — 150 D. Sph. ⌒ + 2.00 D. Cyl. axis 75.
O. S. — 1.25 D. Sph. ⌒ + 0.50 D. Cyl. axis 90.

Tait Net.

O. D. + 1.75 D. Cyl. axis 75. V. A. 15/200.
O. S. — 0.25 D. Sph. ⌒ + 0.25 D. Cyl. axis 90. V. A. 20/20.

With the above correction in place she had 3△ of Exophoria at 6 M. Peckham Gross finding.

O. D. + 0.75 D. Sph. ⌒ + 2.00 D. Cyl. axis 75. V. A. 10/200.
O. S. + 1.25 D. Sph. ⌒ + 0.25 D. Cyl. axis 90. V. A. 20/200.

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Subjective finding.
O. D. — 0.75 D. Sph. ⌒ + 1.75 D. Cyl. axis 75. V. A. 20/20.
O. S. — 1.25 D. Sph. ⌒ + 0.25 D. Cyl. axis 90. V. A. 20/20.
Habitual Phoria 3△ Exophoria.
Abduction: 5 P. D./ 8 P. D./6 P. D.
Adduction: 7 P. D./10 P. D./4 P. D.
Superduction: 4 P. D./0.
Infraduction: 2 P. D./1 P. D.
1/2 △ of right hyperphoria at 6 M.
5 △ of Exophoria at 33 cm.
Positive Reserve: X/28 P. D./4 P. D.
Negative Reserve: 14 P. D./X. Patient sees one after complete blur at 10 P. D.
Minus lens, blur at 0.75 D.
Plus lens, blur at 1.75 D.
Amplitude of Accommodation. O. U. 6.00 D. O. D. 4.50 D. O. S. 6.00 D.

I, therefore, prescribed the following correction to be used as much as possible in addition to treatments:

O. D. + 1.25 D. Cyl. axis 80. V. A. = 15/200.
O. S. — 0.25 D. Sph. ⌒ + 0.25 D. Cyl. axis 90. V. A. 20/20.

The treatments themselves consisted of two types. First, those employed chiefly to stimulate the retinal centers and second those used to secure greater relaxation. Patient came to office daily.

The technic used in giving the treatment was as follows: In the first type of treatment two sizes of pin hole disc were used. The first had an aperture 2 1/2 mm in diameter and the other an aperture of but 1 mm in diameter. A moving distance target was viewed through the disc with the large aperture and a flashing light was viewed through the disc with the small aperture. About thirty minutes of this was done daily in the effort to stimulate the retinal centers of the right eye. In addition to this, base-in relaxation treatments were also given daily for from 10 to 15 minutes. In these latter treatments most of the base-in prism was kept before the poorer eye, which in this case was the right.

A fit over grab front was also prescribed for from two hours to four hours use each day. This had the following lenses.

O. D. Plano ⌒ 4 P. D. base-in.
O. S. Plano

This grab front base-in prism correction was given to amplify the treatments given at the office and to secure greater relaxation in the shortest possible time.

After two months of this rather vigorous treatment the refractive findings were as follows:

Static skiametry.
O. D. — 0.50 D. Sph. ⌒ + 1.25 D. Cyl. axis 80. V. A. = 20/20.
O. S. + 0.37 D. Sph. V. A. = 20/20.

Subjective findings.
O. D. — 0.25 D. Sph. ⌒ + 1.00 D. Cyl. axis 80. V. A. = 20/20.
O. S. + 0.25 D. Sph. V. A. = 20/20.
Tait Net.
O. D. + 0.50 D. Sph. ⌒ + 1.25 D. Cyl. axis 80. V. A. = 20/40+.
O. S. +0.37 D. Sph. V. A. = 20/20.
1/2 △ exophoria with this finding at 6 M.
Peckham Gross.
O. D. + 2.75 D. Sph. ⌒ + 1.50 D. Cyl. axis 80. V. A. = 20/200.
O. S. +2.50 D. Sph. ⌒ +0.25 D. Cyl. axis 90. V. A. = 20/200.

With a new treatment correction of,

O. D. + 1.00 D. Cyl. axis 80. V. A. = 20/30.
O. S. + 0.25 D. Sph. V. A. = 20/20.

comfortable distance and near vision was secured. At this point treatments were discontinued, the case to be kept under observation at monthly intervals.

Case 2.

Patient, boy age 13. Occupation, student.
Patient had never used a correction. His uncorrected visual acuity was as follows:

O. D. 20/40 minus 2 letters.
O. S. 10/200.

Patient right handed. The external ocular inspection and the ophthalmoscopic examination were negative. Pupillary reflex normal. The refractive findings were as follows:
Ophthalmometer.
O. D. Prim. 45.00 D. in 180 mer. X Sec. 46.25 D. in 90 mer.
O. S. Prim. 44.00 D. in 180 mer. X Sec. 47.50 D. in 90 mer.
Static skiametry.
O. D. — 2.50 D. Sph. ⌒ + 0.50 D. Cyl. axis 90. V. A. = 20/20.
O. S. — 4.50 D. Sph. ⌒ + 3.50 D. Cyl. axis 90. V. A. = 20/300.
Tait Net. (A dynamic finding)
O. D. — 0.75 D. Sph. ⌒ +0.50 D. Cyl. axis 90.
O. S. — 1.25 D. Sph. ⌒ + 4.00 D. Cyl. axis 90.
Peckham Gross.
O. D. — 1.50 D. Sph. ⌒ +1.25 D. Cyl. axis 90.
O. S. — 1.75 D. Sph. ⌒ + 4.25 D. Cyl. axis 90.

After two visits to the office I could get neither the phoria nor the duction findings as he was sure that he could not use the left eye and would make no effort to do so. I, therefore, prescribed the following correction for constant wear.

O. D. — 1.00 D. Sph. ⌒ + 0.50 D. Cyl. axis 90. V. A. = 20/30.
O. S. — 2.00 D. Sph. ⌒ + 2.00 D. Cyl. axis 90. V. A. = 20/300?.

In addition to this I prescribed a fit over grab front with the following correction:

O. D. Plano ⌒ 2 P. D. base-in.
O. S. Plano ⌒ 3 P. D. base-in.

This to be used at least three hours each day.

In addition to these corrections, daily treatments at the office were also prescribed. At first the treatments were given only to stimulate the retinal centers of the left eye, these being given with the flashing light and the pin-hole disc. As vision improved, base-in prism treatments were added to this.

After several months of treatment patient started practicing hand-ball in a hand-ball court with the right eye occluded. This was naturally difficult and it was found that by using a red hand-ball he was able to make some progress. His vision was, at first, too poor to enable him to see a black ball.

Daily office treatments were given for a five-month period. At the end of this time his visual acuity with the treatment correction prescribed five months previously was as follows:

O. D. 20/20.
O. S. 20/60 minus one letter.

His refractive findings were at this time as follows:

Static skiametry.
O. D. — 1.25 D. Sph. ⌒ + 1.00 D. Cyl. axis 90. V. A. = 20/20 blurred.
O. S. — 2.50 D. Sph. ⌒ + 4.25 D. Cyl. axis 90. V. A. = 20/80.
Subjective findings.
O. D. — 0.75 D. Sph. ⌒ + 1.00 D. Cyl. axis 90. V. A. 20/20.
O. S. — 2.00 D. Sph. ⌒ + 3.00 D. Cyl. axis 90. V. A. 20/60 blurred.

Treatments were continued for another six weeks and the refractive findings were found to be as follows:
Static skiametry.
O. D. — 0.75 D. Sph. ⌒ +0.75 D. Cyl. axis 90. V. A. = 20/20.
O. S. — 1.50 D. Sph. ⌒ + 3.75 D. Cyl. axis 90. V. A. = 20/30.
Tait Net (dynamic).
O. D. —0.25 D. Sph. ⌒ + 0.75 D. Cyl. axis. 90.
O. S. — 0.75 D. Sph. ⌒ + 4.00 D. Cyl. axis 90.

With the above correction he had 1 △ of Esophoria at 6 M.

Peckham Gross.
O. D. + 0.25 D. Sph. ⌒ + 1.00 D. Cyl. axis 90.
O. S. + 1.50 D. Sph. ⌒ + 3.75 D. Cyl. axis 90.
Subjective:
O. D. — 0.50 D. Sph. ⌒ + 0.50 D. Cyl. axis 90. V. A. = 20/20.
O. S. — 1.75 D. Sph. ⌒ + 3.75 D. Cyl. axis 90. V. A. = 20/30.

With the above the ductions and phorias were as follows:

At 6 M he had 1 △ of Esophoria. His abductions were X/5/0, and his adduction X/10/4. He had 3 △ of Exophoria at the near-point, and his amplitude of accommodation was either O. D. or O. S., 12 D. Circumstances made it impossible to give him further treatments.

Case 3.

Patient, Miss M. W. Age 26. Occupation, cashier. This patient came to me wearing the following correction:

O. D. + 0.50 D. Sph. ⌒ + 1.00 D. Cyl. axis 90. V. A. = 20/20.
O. S. + 0.25 D. Sph. ⌒ + 2.50 D. Cyl. axis 75. V. A. = 20/60.

Her chief symptom was a more or less constant headache. Dull in character and more or less frontal in location.

The external ocular inspection and the ophthalmoscopic examination were both negative. The pupillary reflex was normal. The ophthalmometer findings were:

O. D. Prim. 40.75 D. in 180 mer. X Sec. 41.75 D. in 90 mer.
O. S. Prim. 41.00 D. in 170 mer. X Sec. 45.00 D. in 80 mer.

Static skiametry.
O. D. — 0.25 D. Sph. ⌒ + 0.75 D. Cyl. axis 90. V. A. = 20/20.
O. S. — 1.00 D. Sph. ⌒ + 3.25 D. Cyl. axis 75. V. A. = 20/40.

Tait Net (dynamic).
O. D. + 1.00 D. Sph. ⌒ + 1.00 D. Cyl. axis 90.
O. S. + 0.50 D. Sph. ⌒ + 3.50 D. Cyl. axis 60.

With the above finding the patient had 1/2 △ of Esophoria.

Peckham Gross.
O. D. + 1.75 D. Sph. ⌒ + 0.75 D. Cyl. axis 90.
O. S. + 1.50 D. Sph. ⌒ + 4.00 D. Cyl. axis 70.

Subjective.
O. D. + 0.50 D. Sph. ⌒ + 0.50 D. Cyl. axis 90. V. A. = 20/20.
O. S. — 2.00 D. Sph. ⌒ + 3.75 D. Cyl. axis 80. V. A. = 20/30.

With the above finding the patient had 1 △ of Exophoria.

In the effort to reduce the minus correction before the left eye I prescribed the following correction, in addition to treatments.

O. D. + 0.50 D. Sph. ⌒ + 0.50 D. Cyl. axis 90. V. A. = 20/20.
O. S. + 3.00 D. Cyl. axis 80. V. A. = 20/60.

With this treatment correction the ductions and phorias were as follows: Abduction 4/6/2. Adduction 10/13/4. 9 △ of Exophoria at the near point. Amplitude of accommodation O. U. 8 D.

Office treatments as already outlined and the use of part time base-in were prescribed. Treatments (three each week) were given for a period of six months. At the end of this period I prescribed the following correction which enabled her to have nearly normal vision with comfort.

O. D. + 0.50 D. Sph. ⌒ + 0.75 D. Cyl. axis 90. V. A. = 20/20.
O. S. + 0.50 D. Sph. ⌒ + 3.50 D. Cyl. axis 85. V. A. = 20/24.

These three case reports are taken from some 15 similar reports now in my files. In each case it was possible to materially reduce the minus correction, and at the same time, improve the visual acuity of the poor eye.

DR. ROBERT BEST,
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INCIPIENT CATARACTS*

J. O. Baxter, Sr., Opt.D.
New Bern, N. C.

Cataracts are supposed by many to be a natural sequence or penalty of advancing years. This is not true, for younger patients are also subject to the disease and the many morbid conditions that are associated with it.

It, therefore, appears that there must be other causes than senility that predispose or cause cataracts. In view of the fact that many ophthalmologists do little other than wait for the operative stage, it would seem that the optometrist may render distinctive service in the treatment of cataracts, especially the incipient cases.

The so-called "Second Sight" is probably the first noticeable stage of cataracts. In an elderly patient whose correction calls for a decrease of a plus correction or an increase of the minus, the examiner should at once suspect cataracts in the offing, if not yet present. Spots or striae should be carefully searched for on or within the lens. Although we have observed beneficial results in the treatment of the later stages of cataracts, yet there is no doubt, as we have found, the greatest good may be accomplished by the treatment of cataract in the early stages.

As an organ can scarcely become impaired as long as it is healthy, suggests the idea in the treatment of cataracts of first establishing and then maintaining the healthy nutrient force of the crystalline lens, and as the lens have no direct blood supply it is being nourished by the absorption of the lymph, ultimating from the uvea and through the aqueous, etc.

In the first place, in the prevention and treatment of cataracts, it is first necessary that the source of supply of lymph to the lens is normal, and in the second place, that the lens is enabled to absorb enough of this healthy nutrient force to keep it normal.

We, therefore, are brought face to face with the factor that is responsible for most eye diseases—the general health of the whole body. Consequently, the optometrist must call on the family doctor for assistance, or the dentist, to determine whether or not the lens is receiving a toxic or contaminated food supply. If the lens is absorbing a toxic laden supply of lymph, one may not expect it to remain healthy.

*Submitted for publication June 12, 1933.

Consequently, the dentist must determine if the teeth are responsible for infectious material into the blood stream, and the family doctor if there are other infections and disease within the body. The optometrist should see that the patient rigorously adheres to whatever treatment is prescribed.

The patient should be advised in the general rules of health, sunlight, diet, sleep, exercise, etc., and especially the free drinking of water.

Etiology of Cataracts

(a) The lack of lymph which results in the death of the lens tissue by starvation of its fibers.

(b) The alteration of the composition of the aqueous or lens tissue, by a disturbance of metabolism, i.e., such as occur in diabetes or nephritis, or an accumulation of toxic decomposition products by disease in other parts of the body, which may cloud the lens on account of deleterious effects upon the lens tissue, or by actually forming opaque deposits upon the lens.

(c) With the patients in the second class, it would appear that their lens was vulnerable to the action of light, especially the ultra violet radiations. Burge found by experiment that lenses exposed to light became opaque, provided that they were charged with sugar or certain chemical salts. (Calcium silicon magnesium.) It further appears that cataractous lenses do contain an unusual amount of magnesium and calcium salts, and in the case of Indian cataracts an unusual amount of silicon. If these findings hold true in general, it would seem that the action of light upon lenses which have an altered chemistry due to a disordered metabolism, is a factor in producing cataracts. It is highly probable that the action of light upon lenses charged with sugar, as in diabetes, may produce cataracts.

The treatment of cataracts as herein outlined in addition to the protection of the patient's eyes from the infra red and ultra violet light has been the source of much satisfaction to the writer. The treatment and examination as essentially outlined in the following case report is that generally followed in most all cases of cataracts.

Mrs. S., age 68, July, 1931. The corrected vision of the right eye was 100 per cent, the left, 60 per cent. Well defined incipient cataract was found in the left and a slight opacity within the right lens.

The history revealed photophobia, pyelitis, pain in the eyes, gall bladder disease and constipation. She drank very little water. Palpation revealed ciliary tenderness. Systolic blood pressure 120. The buccal cavity was negative. The patient was well nourished and so far as external appearance went, she appeared otherwise healthy.

She was instructed to have her family physician persist in his treatment of her general condition, with further advice to drink plenty of water; to take mild daily exercise in the open air and sun and, to encourage the free passage of lymph to prevent stasis, was told to persist in massaging the globe of the eyes and to rotate the eyes to the full limit

of the various fields. Glycerine and boric acid were prescribed as a possible aid. Her correction included bifocals that filtered both the infra-red and ultra-violet light.

Within thirty days the vision of the right eye was 115 per cent and the left had increased from 60 to 90 per cent.

January 1, 1933, the plus correction has increased 0.50D in each eye. The visual acuity of the right eye is still 115 per cent and the left 100 per cent. There still remain a few slight opacities in the left lens. The increase of the plus correction indicates that the swelling or increased index of refraction of the lens has decreased and the gain in visual acuity, that the opacities of the lenses have partly subsided.

In this case it is possible that either the hygienic treatment or the massaging and exercise of the eyes to increase the flow of lymph or the filtering of the possibly irritative invisible radiation to protect the lens after the altered chemistry of the eye or body had made them vulnerable to cataracts, could either have individually succeeded in relieving the disease. I believe, however, that owing to the difficulty in determining the exact cause of cataracts that full measures should be instigated.

In the event that a vascular stasis was the only etiologic factor underlying the lenticular degeneration, and which no doubt may be chiefly the cause in the period of declining vital forces, associated with the difficulty of the lens degeneration and choked vascular system. Then, no doubt, the increase of lymph to the starving lens fibers by systematic exercise, massage and lymphogogs may at least arrest the disease or repair the damage of the lenses if taken in time.

It is probable that in eye diseases falling in this category that the advocates of the use of the various exercising instruments occasionally shine bright in the reports of their successes.

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THE AMOUNT OF BASE-OUT PRISM THAT CAUSES A BLUR AT A DISTANCE

Some call the results of this test the *adduction,* while others refer to it as the *true adduction,* but, irrespective of its name, it is in reality a measurement of the power of convergence that may be forced without calling accommodation into play. Walker in a very complete report[1] on diagnostic refractive findings, published in the 1933 Academy Year Book, points out that unless the fixation target is a proper one, the results of this test are apt to be incorrect. He makes the following suggestion on the technics used in taking this true adduction finding. In using prisms base-out, or base-in, he has found that prismatic aberration on vertical lines to be a factor that cannot be overcome, and therefore suggests, that in making this blur test, that we base the interpretations upon the blurring of a set of very fine horizontal lines. The Clason instrument has just the right kind of a chart for this purpose. In using this instrument select the disc with the horizontal lines in the astigmatic chart, stop off all of the other astigmatic balls with the small circular aperture. Next, bring the lines from invisible to visible upon the screen, stopping at a point where

[1]Walker, R. N. Vol. VII. The American Academy of Optometry, pages 172-197, 1933.

the patient can see the horizontal lines clearly. Now turn prism base-out over each eye, one prism dioptre at a time. This must be done very slowly. The point where the patient cannot see the lines, after allowing five seconds time to elapse to enable them to clear, is the measurment of the true adduction. In an orthophoric case the expected is around 12 △. base-out. C. C. K.

* * * * *

CHALAZION

As optometrists we are frequently called upon to suggest relief measures for patients suffering from a chalazion. These small tumours of the lid, while not particularly painful, are nevertheless sometimes annoying as the pressure caused by the swelling of the lid makes the patient aware of the abnormality and also from the standpoint of appearance a chalazion is an unsightly and objectionable thing. The remedy is surgical. The tumour is removed, usually through a small incision made in the inner portion of the lid.

As to the origin of a chalazion, Meadly[1] finds that this chronic affection originates in the Meibomian glands, and is firmly attached to the tarsus. The initial stages of the condition, from the microscopical point of view, consist in a proliferation of the epithelium of the acinus of the gland and an inflammatory infiltration develops in the adjacent tissue of the tarsus. As the inflammatory process advances the acini of the gland and the surrounding tarsal tissue are often hidden in a mass of small cells. This infiltration of small cells forms a soft tissue, of the type known as granulation tissue, which is enclosed by a capsule of connective tissue. The capsule is formed from the external tissue of the tumour which is continually being compressed as growth proceeds, and although it functions as a limiting membrane to the inflammatory condition, it never forms a true cyst wall. The granulation tissue contains, in addition to the mass of small cells, other cells of large size called giant cells. Later, owing to the central portions of the Chalazion, being sparsely supplied with blood vessels, the granulation tissue undergoes a kind of fatty degeneration and may eventually break down forming a viscid liquid. This latter condition is often found in old Chalazia. C. C. K.

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HYPERPHORIAS AND SQUINT

In discussing various instruments used in treating squint and amblyopia, Rosen[2] finds but one important fault, that being that in none of these instruments has provision been made for allowing the eye to

[1]Meadly, J. C. Pathological Conditions of the Eye Seen Microscopically. British Journal of Physiological Optics. Vol. VII, No. 1, pp. 11-17.

[2]J. Rosen. Ocular Myology. British Journal of Physiological Optics. Vol. VII, No. 1, pp. 6-11, 1933.

turn directly from its position of deviation to the primary position in an oblique plane. If, for instance, in a case of convergent squint the eye has assumed an oblique position and we, therefore, find an hyperphoric measurement, we correct this hyperphoria by means of prisms and throughout the treatment insist that the eye should rotate in this raised position in spite of the fact that the natural inclination of the eye may be to reach the primary position along an oblique or curved path. If we are successful in correcting the squint we will usually find that the hyperphoria measured at the start of the treatment period is no longer there. He, therefore, suggests that even apart from present methods and nomenclature our ideas on muscle balance need revision, and it seems advisable to divide hyperphoria into two classes—

Primary Hyperphoria—due to imbalance of the vertical recti and providing cases that obtain immediate relief from correcting prisms.

Secondary Hyperphoria—associated with and the result of medium or high horizontal deviations, and possibly having concomitant cyclophoria.

This latter type probably includes cases of hyperphoria of 3 △ or more, which have no asthenopic symptoms, and the similar cases which will not tolerate correcting prisms, since in both these types the vertical error is non-existent when the horizontal imbalance is overcome. C. C. K.

* * * * *

SUGGESTIONS FOR TESTING DARK ADAPTATION

Morton[1] claims that with present methods of testing dark adaptation, doubt may arise as to the correctness of the modus operandi and the value to be attached to the results of these tests. He wonders whether most of our present light sense tests, as now in use, give the correct indication of the state of the light-sense fusion. He feels that we should more fully obtain the expressions of the paramacular and peripheral regions which more truly express dark adaptation value than do the findings taken on the macular area. In his opinion the macular area has to do with visual acuity while the peripheral field has to do with light discrimination. Morton suggests, therefore, that preliminary to the test for dark adaptation, the eyes should be in darkness for considerably longer than the period usually employed. Also that in whatever type of photometer is used calibration is an important consideration. Another detail must receive attention—the elimination of macular fixation toward the first incoming source of light. This may be obtained by having the eye fix toward a point thirty to forty-five degrees to one side of this point. The apparatus should be so constructed that the lower

[1]H. McI. Morton. Amblyopia ex Anopsia. American Journal of Ophthalmology. Vol. 14, No. 3, pp. 239-244.

part of the face may project under, and thus permit the eye under test to be well within the edge of the opening. This permits of turning the eye in a direction away from the back of the box, from which the light stimulus first appears. Morton has found this method simple and practical, and believes it gives better index of function than is obtained by the usual method of having the eye fix directly forward.

Calibration is, he finds, essential for correct interpretation of comparative values and relationships of reports of different observers. Different apparatus may express different values, arising from different types of construction, varying degrees of illumination, and dissimilar methods of calibration. In this regard, it is not unlike the testing of the visual field under different light intensities, different degrees of saturation and size of test objects. In photometers the initial light stimulus may be the same, but, owing to differences in construction, there may be more absorption of this stimulus in one than in the other before it reaches that point where the light stimulus finally emanates. Again, differing calibration makes impossible the comparison of the thresholds of light perception. His remarks apply even more in photometric than in visual field tests. In the latter we obtain more nearly an average normal of light stimulation, since we are dealing with natural light. In photometric tests, where we are generating a light stimulus, much depends upon correct calibration to insure that readings shall be actually and comparatively correct.

C. C. K.

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CAUSES OF ASTHENOPIA

The three chief causes of asthenopia are: first, small amounts of uncorrected astigmatic errors; second, anisometropia of low degree and third, marked accommodative-convergence imballances. According to Laurance[1] the asthenopia caused by astigmatism is due to the resulting unequal accommodative action in the two principal meridians of the eye. Obviously asthenopia can occur only in cases of low degrees of astigmatism because in a case of high degree, differential accommodation or what is sometimes called sectional accommodation is impossible. It is also more prevalent in hyperopes than in myopes, the reason for this being that in a hyperope with a small amount of uncorrected astigmatism the fatigue developed by the unequal action of accommodation on the lens in the effort to overcome the astigmatism is constant, being in play for both distance and near, while in a myope, it would be in effect only when the eyes were used at the near point.

The asthenopia resulting from anisometropia is due to the unequal accommodative action of the two eyes. Here too, this can occur only in cases showing low degrees of anisometropia, as a large difference in the accommodative action of the two eyes is impossible.

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[1]Laurance, L. The Routine of Subjective Testing. p-6. Lecture New York City. June, 1921.

Anisometropia resulting from imballances of the accommodative-convergence relationship are usuallv the result of a lack of harmony between these two functions caused by either a lack of accommodation, faulty refraction or an innervational defect to the extrinsics. It is obvious therefore that, frequently cases showing but slight errors of refraction may be the ones with the most pronounced symptoms and it also indicates the need for accurate work in correcting all errors of refraction inasmuch as slight mistakes in the correction may in themselves produce asthenopic symptoms which in time may be more severe than were the original ones. C. C. K.

BOOK NOTICES

THE FOCAL POWER OF OPHTHALMIC LENSES. A. Estelle Clancy, Ph.D., Research Division, American Optical Co. 46 pages. Paper covers. 1933.

This monograph was published for those who must frequently deal with questions concerning the precise power of spectacle lenses. It is an authoritative, scientific treatise, and is carefully and thoroughly written. The reader will find it complete but not difficult to read. The contents are divided into two sections. Important information in Section I includes formulas for computing the Approximate Power, Equivalent Power, Effective Power, and Neutralizing Power of lenses, and tables showing how those powers vary with the form of the lens.

Section II defines the oblique power of a spectacle lens, and continues the discussion of the power along the axis of a lens. How the effectivity of a lens is measured if its position is changed, is fully explained. A table is given showing the effect of lens thickness on power. The principles on which additive trial sets and phoroptors are made is set forth in understandable terms. Actual examples are given of the computation of lenses in a trial set. These are but a few of the details covered. The entire booklet is written from a practical viewpoint. The statements made, the formulas given and charts shown are sound in theory and practice. "The Focal Power of Ophthalmic Lenses" is available to students, practitioners and shopmen, on request. J. I. K.

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OCULAR MUSCLES AND FUSION, Thomas G. Atkinson, M.D. Published by the Professional Press, Chicago, Ill. 192 Pages. Illustrated, Cloth Covers, $3.50, 1933.

In writing this book of Ocular Muscles and Fusion, Atkinson contends that in our work we are laying too much stress upon optics and mathematics and not enough upon physiology and psychology, as he so clearly states in his introduction. This book was written to furnish the basic information to change "muscle work" from a sheer system of

meaningless mathematical notation into a vital means of physiologic, pathologic and psychologic diagnosis.

The Ocular Mechanism he describes and graphically illustrates as consisting of three levels of neural operation which serve to coordinate the ocular function (1) *Conscious level*—Reflex sensitization and inhibition. (2) *Subconscious level*—Phycho reflexes, (3) *Unconscious level*—Physical reflexes.

The greater part of the book is devoted to trying to give physiological and psychological meaning to our numerous ocular tests which are now used emperically by most refractionists. Of special interest is a chart devised by the author for the differentiation and interpretation of the muscle tests showing the possible seat of the trouble, whether it be physiologic, pathologic or phychic giving the types of tests to be used, and suggesting the kinds of optometric treatments to be given.

In his chapter on treatment he states: "Remedy the faulty muscle or nerve if possible. If a mal-insertion correct it, surgically. If a spasm or contracture, massage and electrotheraphy will often be effective. If a diseased muscle, give appropriate medical care. If a poorly developed muscle, give suitable calisthenics and upbuilding treatments."

He concludes the book by giving a complete discussion of squint and the methods of treating it. He describes all the instruments of importance which are today available, and cautions the reader not to make the mistake of adapting "systems" of treatment as there can be no hard or fast rule laid down for a system of dealing with human ailments.

J. I. K.

Who Remembers